Chapter 1 General Information

1.1 Manual Description

1.1.1 Purpose

The Bridge Design Manual (BDM) is a guide for those who design bridges for the Washington State Department of Transportation (WSDOT). The BDM supplements the AASHTO LRFD Specifications. It explains differences where it deviates from the AASHTO LRFD Specifications. It contains standardized design details and methods, which are based on years of experience.

The BDM is a dynamic document, which constantly changes because of the creativity and innovative skills of our bridge designers and structural detailers. It is not intended for the design of unusual structures or to inhibit the designer in the exercise of engineering judgment. There is no substitute for experience, good judgment, and common sense.

1.1.2 Specifications

The AASHTO LRFD Bridge Design Specifications and the WSDOT Bridge Design Manual (BDM) are the basic documents used to design highway bridges and structures in Washington State.

The WSDOT BDM supplements the AASHTO Specifications by providing additional direction, design aides, examples, and information on office practice. The BDM takes precedence where conflict exists between the BDM and the AASHTO Specifications. The WSDOT Bridge Design Engineer will provide guidance where a conflict still exists.

The BDM does not duplicate the AASHTO Specifications. References are listed at the end of each chapter.

1.1.3 Format

A. General

The Bridge Design Manual consists of two volumes with each chapter organized as follows:

Criteria or other information

Appendix A (printed on yellow paper) Design Aids

Appendix B (printed on salmon paper) Design Examples

B. Chapters

1. General Information
2. Preliminary Design
3. Loads
4. Seismic Design and Retrofit
5. Concrete Structures
6. Steel Design
7. Substructure
8. Walls and Buried Structures

9. Bearings and Expansion Joints
10. Traffic Barriers, Sign Structures, Approach Slabs, Utility Supports
11. Detailing Practice
12. Quantities, Construction Costs, and Specifications
13. Bridge Rating

C. Numbering System

1. The numbering system for the criteria consists of a set of numbers followed by letters as required to designate individual subjects. This format is similar to that used by AASHTO.

   Example:

   Chapter 5 Concrete Structures (Chapter)

   5.3 Reinforced Concrete Box Girder Bridges (Section)

   5.3.2 Reinforcement (Subsection)

   A. Top Slab Reinforcement

   1. Near Center of Span

   a. Transverse Reinforcement

2. Numbering of Sheets

   Each section starts a new page numbering sequence. The page numbers are located in the lower outside corners and begin with the chapter number, followed by the section number, then a sequential page number.

   Example: 5.3-1, 5.3-2, etc.

3. Appendices are included to provide the designer with design aids (Appendix A) and examples (Appendix B). Design aids are generally standard in nature, whereas examples are modified to meet specific job requirements.

   An appendix is numbered using the chapter followed by section number and then a hyphen and the letter of the appendix followed by consecutive numbers.

   Example: 5.3-A1 (Box Girder Bridges) designates a design aid required or useful to accomplish the work described in Chapter 5, Section 3.

4. Numbering of Tables and Figures

   Tables and figures shall be numbered using the chapter, section, subsection in which they are located, and then a hyphen followed by consecutive numbers.

   Example: Figure 5.3.2-1 is the first figure found in Chapter 5, section 3, subsection 2.

1.1.4 Revisions

A. Manual Updates

The Bridge Design Manual will change as new material is added and as criteria and specifications change.

Designers shall check any for BDM updates issued by the Bridge and Structures Office as Design Memorandums. These are posted on the following website: www.wsdot.wa.gov/eesc/bridge/bdm and are incorporated into the BDM as soon as possible.

Revisions and new material will be issued with a Publications Transmittal Form. The form will have a revision number and remarks or special instructions regarding the sheets. The revision number shall be entered on the Record of Revision sheet in this manual. This allows the user to verify that the manual is up to date.

B. Bridge Design Instruction

Special instructions regarding interpretation of criteria or other policy statements may be issued using a Bridge Design Instruction (BDI). The BDI will be transmitted in the same manner as outlined above for manual revisions. The BDI should be inserted in the appropriate place in the manual and remains in effect until the expiration date shown or until superseded by a revision to the manual.

C. Record of Manual Revisions

In order that a ready means be available to check whether a manual is up to date, each manual holder is requested to keep his copy up to date and to record Bridge Design Instructions or Revisions as material is added or changed. The form below is intended for use in keeping this record. At any time, a manual holder will be able to check his list with the list in the "master" manual.

Revision Number	Entry Date	By (Initial)	Revision Number	Entry Date	By (Initial)	Revision Number	Entry Date	By (Initial)

Record of Manual Revisions
Table 1-1

1.2 Bridge and Structures Office Organization

1.2.1 General

The responsibilities of the Bridge and Structures Office are:

Provides structural engineering services for WSDOT. Provides technical advice and assistance to other governmental agencies on such matters.

The WSDOT Design Manual states the following:

Bridge design is the responsibility of the Bridge and Structures Office in Olympia. Any design authorized at the Region level is subject to review and approval by the Bridge and Structures Office.

1.2.2 Organizational Elements of the Bridge Office

A. Bridge and Structures Engineer

The Bridge and Structures Engineer is responsible for structural engineering services for the department and manages staff and programs for structural design, contract plan preparation, inspections and assessments of existing bridges.

B. Bridge Design Engineer

The Bridge Design Engineer is directly responsible to the Bridge and Structures Engineer for structural design and review, and advises other divisions and agencies on such matters.

1. Structural Design Units

The Structural Design Units are responsible for the final design of bridges and other structures. Final design includes preparation of contract plans. The units provide special design studies, develop design criteria, check shop plans, and review designs submitted by consultants. Frequently, the Bridge Projects Engineer assigns the units the responsibility for preparing preliminary bridge plans and other unscheduled work.

The Bridge Engineer Supervisor (Unit Supervisor) provides day-to-day leadership, project workforce planning, mentoring, and supervision for the design unit. Organization and job assignments within the unit are flexible and depend on projects underway at any particular time as well as the qualifications and experience level of individuals. The primary objective of the design units is to produce contract plans for bridges and structures within scope, schedule and budget. This involves designing, checking, reviewing, and detailing in an efficient and timely manner.

A bridge specialist is assigned to each design unit. Each specialist has a particular area of expertise. The three major areas are: concrete, steel, expansion joints and bearings. The specialists act as a resource for the bridge office in their specialty and are responsible for keeping up-to-date on current AASHTO criteria, new design concepts and products, technical publications, construction and maintenance issues, and are the primary points of contact for industry representatives.

The design units are also responsible for the design and preparation of contract plans for modifications to bridges in service. These include bridge rail replacement, deck repair, seismic retrofits, emergency repairs when bridges are damaged by vehicle or ship collision or natural phenomenon, and expansion joint and drainage retrofits. They review proposed plans of utility attachments to existing bridges.

2. Bridge Projects Unit

The Bridge Projects Engineer directs preliminary design work, specification and cost estimates preparation, falsework review, project scoping, coordinates scheduling of bridge design projects and unscheduled work assignments with the Region Project Development Engineers, Bridge Design Engineer, and the Unit Supervisors.

The Preliminary Plan Engineers are responsible for bridge project planning from initial scoping to design type, size, and location (TSL) studies and reports. They are responsible for preliminary plan preparation of bridge and walls including assembly and analysis of site data, preliminary structural analysis, cost analysis, determination of structure type, and drawing preparation. They also check preliminary plans prepared by others, review highway project environmental documents and design reports, and prepare U. S. Coast Guard Permits.

The Specifications and Estimate (S&E) Engineers develop and maintain construction specifications and cost estimates for bridge projects. They also develop specifications and cost estimates for bridge contracts prepared by consultants and other government agencies, which are administered by WSDOT. They assemble and review the completed bridge PS&E before submittal to the Regions. They also coordinate the PS&E preparation with the Regions and maintain bridge construction cost records.

The Construction Support Unit Engineers are responsible for checking the contractor's falsework, shoring, and forming plans. Shop plan review and approval are coordinated with the design units. Actual check of the shop plans is done in the design unit. Field requests for plan changes come through this office for a recommendation as to approval.

The Bridge Plans Engineer processes as-built plans in this unit. Region Project Engineers are responsible for preparing and submitting as-built plans at the completion of a contract.

The Scheduling Engineer monitors the design work schedule for the Bridge and Structures Office, updates the Bridge Design Schedule (BDS) and maintains records of bridge contract costs. Other duties include coordinating progress reports to Regions by the Unit Supervisors and S&E Engineers through the Project Delivery Information System (PDIS).

In addition, the unit is responsible for updating the Bridge Design Manual. The unit coordinates Standard Plan changes through the Bridge Construction Office, changes to the WSDOT Standard Specifications and design standards, professional activities, and AASHTO reviews.

C. Bridge Preservation Engineer

The Bridge Preservation Engineer directs activities and develops programs to assure the structural and functional integrity of all state bridges in service. The Bridge Preservation Engineer directs emergency response activities when bridges are damaged.

1. Bridge Preservation Office (BPO)

The Bridge Preservation Office is responsible for planning and implementing an inspection program for the more than 3,200 fixed and movable state highway bridges. In addition, BPO provides inspection services on some local agency bridges and on the state's ferry terminals. All inspections are conducted in accordance with the National Bridge Inspection Standards (NBIS).

BPO maintains the computerized Washington State Bridge Inventory System (WSBIS) of current information on more than 7,300 state, county, and city bridges in accordance with the NBIS. This includes load ratings for all bridges. BPO prepares a *Bridge List* of the state's bridges, which is published every two years, maintains the intranet-based Bridge Engineering Information System (BEIST), and prepares the annual Recommended Bridge Repair List (RBRL) based on the latest inspection reports.

BPO is responsible for the bridge load rating and risk reduction (SCOUR) programs. It provides damage assessments and emergency response services when bridges are damaged because of vehicle or ship collision or natural phenomenon such as: floods, wind, or earthquakes.

D. Bridge Management Engineer

The Bridge Management Unit is responsible for the program development, planning and monitoring of all statewide bridge program activities. These include P2 funded bridge replacements and rehabilitation, bridge deck protection, major bridge repair, and bridge painting.

In addition, the Bridge Management Unit manages the bridge deck protection, deck testing and the bridge research programs. It is responsible for the planning, development, coordination, and implementation of new programs (e.g., Seismic Retrofit and Preventative Maintenance), experimental feature projects, new product evaluation, and technology transfer.

The Bridge Management Engineer is the Bridge and Structures Office's official Public Disclosure contact. (See Section 1.3.8 Public Disclosure Policy Regarding Bridge Plans).

E. Computer Support Unit

The Computer Support Unit is responsible for computer resource planning and implementation, computer user support, liaison with Management Information Systems (MIS), computer aided engineer operation support, and software development activities. In addition, the unit works closely with the Bridge Projects Unit in updating the BDM and Standard Plans.

F. Consultant Liaison Engineer

The Consultant Liaison Engineer prepares bridge consultant agreements and coordinates consultant PS&E development activities with those of the Bridge Office. The Consultant Liaison Engineer negotiates bridge design contracts with consultants.

G. State Bridge and Structures Architect

The State Bridge and Structures Architect is responsible for reviewing and approving preliminary plans, preparing renderings, model making, coordinating aesthetic activities with Regions (i.e. suggesting corridor themes), and other duties to improve the aesthetics of our bridges and structures. The State Bridge and Structures Architect works closely with staff and Regions. During the design phase, designers should get the Architect's approval for any changes to architectural details shown on the approved preliminary plan.

H. Staff Support Unit

The Staff Support Unit is responsible for many support functions, such as: typing, timekeeping, payroll, receptionist, vehicle management, mail, inventory management, and other duties requested by the Bridge and Structures Engineer. Other duties include: filing field data, plans for bridges under contract or constructed, and design calculations. This unit also maintains office supplies and provides other services.

I. Office Administrator

The Office Administrator is responsible for coordinating personnel actions, updating the organizational chart, ordering technical materials, and other duties requested by the Bridge and Structures Engineer. Staff development and training are coordinated through the Office Administrator. The Office Administrator also handles logistical support, office and building maintenance issues.

1.2.3 Design Unit Responsibilities and Expertise

The following is an updated summary of design responsibilities/expertise within the Bridge Design Section. Contact the Unit Supervisor for the name of the appropriate staff expert for the needed specialty.

Unit Supervisor	**Responsibility/Expertise**
Karl Kirker	Bearings and Expansion Joints
	Seismic Retrofit
	Retaining Walls (including Structural Earth, Soldier Pile and Tie-Back, and Soil Nail)
	This design unit has primary responsibility for reviewing proposals submitted by retaining wall manufacturers for pre-approval of their wall systems. Once the wall system is preapproved with concurrence from the State Geotechnical Engineer, each design unit is responsible for checking the proprietary retaining wall shop drawings and designs that are submitted on contracts for which they have design responsibility. The Retaining Wall Specialist assigned to this unit handles the preapproval of proprietary retaining walls and is available as a resource for engineers that are performing design checks.
	When proprietary retaining wall shop plans/designs are submitted on unassigned contracts, the Construction Support Unit will assign the shop plan/design review to one of the three design units on a rotating basis.
Mark Anderson	Noise Walls
	Bridge Traffic Barriers
	Standard Plans for Prestressed Concrete
John Van Lund	Coast Guard Permits
	Special Provisions and Cost Estimates
	Falsework, Forming and Temporary Structures
	Standard Plans (other than Prestressed Concrete)
	Bridge Design Manual
Richard Zeldenrust	Sign Supports, Light Standards, Traffic Signal Supports
	Repairs to Damaged Bridges
Patrick Clarke	Floating Bridges
	Special Structures

1.3 Quality Control/Quality Assurance (QC/QA) Procedure

1.3.0 General

A. The purpose of the QC/QA procedure is to improve the quality of the structural designs and plans. The key element to the success of this process is effective communication between all parties. The goals of the QC/QA procedure are:

- Designed structures improve public safety and meet state regulations.
- Designed structures meet the requirements of the WSDOT Bridge Design Manual, AASHTO LRFD Bridge Design Specifications, current structural engineering practices, and geometric criteria provided by the Region.
- Designed structures are aesthetically pleasing, constructible, durable, economical, inspectable, and require little maintenance.
- Design contract documents meet the customer's needs, schedule, budget, and construction staging requirements.
- Structural design costs are minimized.
- An organized and indexed set of design calculations are produced. Design criteria and assumptions are included in the front after the index.
- Plan quality is maximized.
- The QA/QC procedure allows for change, innovation, and continuous improvement.

The goals are listed in order of importance. If there is a conflict between goals, the more important goal takes precedence.

The Unit Supervisor determines project assignments and the QC/QA process to be used in preparation of the structural design. The intent of the QC/QA process is to facilitate plan production efficiency and cost-effectiveness while assuring the structural integrity of the design and maximizing the quality of the structural contract documents.

1.3.1 Design/Check Procedures

A. PS&E Prepared by WSDOT Bridge and Structures Office

1. Design Team

The design team usually consists of the Designer(s), Checker(s), Structural Detailer(s), and a Specification and Estimate Engineer, who are responsible for preparing a set of contract documents on or before the scheduled due date(s) and within the budget allocated for the project. On large projects, the Unit Supervisor may designate a designer to be a Design Team Leader with additional duties, such as: assisting the supervisor in planning, scheduling, coordinating, and monitoring the activities of the design team. In this case, the team leader would also coordinate and communicate with the Region and the Geotechnical Branch.

The QC/QA procedures may vary depending on the type and complexity of the structure being designed, and the experience level of the design team members. More supervision, review, and checking may be required when the design team members are less experienced. In general, it is a good QC/QA practice to have some experienced designers on each design team. All design team members should have the opportunity to provide input to maximize the quality of the design plans.

2. Designer Responsibility

The designer is responsible for the content of the contract plan sheets, including structural analysis, completeness and correctness. Errors and omissions must be discovered and corrected before subsequent checking and review of plans. A good set of example plans, which is representative of the bridge type, is indispensable as an aid to less experienced designers and detailers.

During the design phase of a project, the designer will need to communicate frequently with the Unit Supervisor and other stakeholders. This includes acquiring, finalizing or revising roadway geometrics, soil reports, hydraulics recommendations, and utility requirements. Constructibility issues may also require that the designer communicate with the Region or Construction Office. The designer may have to organize face-to-face meetings to resolve constructibility issues early in the design phase. The bridge plans must be coordinated with the PS&E packages produced concurrently by the Region.

The designer shall advise the Unit Supervisor as soon as possible of any scope and project cost increases and the reasons for the increases. The Unit Supervisor will then notify the Region project office if the delivery schedule will have to be changed. If Region concurs with a change in the delivery date, the Unit Supervisor will notify the Bridge Projects Engineer or the Bridge Scheduling Engineer of the revised delivery dates.

The designer or team leader is responsible for project planning which involves the following:

a. Determines scope of work, identifies tasks, plans order of work, and makes assignments.

b. Prepares a Design Time Estimate. See Section 1.5.3.

c. Prepare design criteria that are included in the front of the design calculations. Compares tasks with BDM office practice and AASHTO bridge design specifications.

   (1) Sufficient guidelines?

   (2) Deviation from BDM/AASHTO?

   (3) Any question on design approach?

   (4) Deviation from office practices regarding design and details?

   (5) Other differences.

d. Meet with the Region design staff and other project stakeholders early in the design process to resolve as many issues as possible before proceeding with final design and detailing.

e. Identify coordination needs with other designers, units, and offices.

f. Early in the project, determine the number and titles of sheets. For projects with multiple bridges, each set of bridge sheets should have a unique set of bridge sheet numbers. The bridge sheet numbering system should be coordinated with the Region design staff.

g. At least monthly or as directed by the design Unit Supervisor:

   (1) Update Project Schedule and List of Sheets.

   (2) Estimate percent complete.

(3) Estimate time to complete.

(4) Work with Unit Supervisor to adjust resources, if necessary.

h. Develop preliminary quantities for 90 percent complete cost estimate.

i. Near end of project:

(1) Keep track of sheets as they are completed.

(2) Develop quantities, *Not Included in Bridge Quantity List*, and *Special Provisions Checklist* that are to be turned in with the plans. (See Figure 1-A-1).

(3) Prepare and check Bar List.

(4) Coordinate all final changes, including review comments from the checker, managers, specialists, the Region, and the Construction Office.

(5) Meet with Region design staff and other project stakeholders at the constructibility meeting to address final project coordination issues.

The designer should inform the Unit Supervisor of any areas of the design, which should receive special attention during checking and review.

The design calculations are prepared by the designer and become a very important record document. Design calculations will be a reference document during the construction of the structure and throughout the life of the structure. It is critical that the design calculations be user friendly. The design calculations shall be well organized, clear, properly referenced, and include numbered pages along with a table of contents. The design calculations shall be archived. Computer files should be archived for use during construction, in the event that changed conditions arise. Archive-ready design and check calculations shall be bound and submitted to the Unit Supervisor within 30 days of submitting the 100 percent PS&E. Calculations shall be stored in the design unit until completion of construction. After construction, they shall be sent to archives. (See Section 1.3.7 Archiving Design Calculations, Design Files, and S&E Files).

The designer is also responsible for resolving construction problems referred to the Bridge Office during the life of the contract. These issues will generally be referred through the Bridge Technical Advisor, the Unit Supervisor, the Construction Support Unit, or the HQ Construction-Bridge.

3. Design Checker Responsibility

The checker is responsible to the Unit Supervisor for "quality assurance" of the structural design, which includes checking the design and plans to assure accuracy and constructibility. The Unit Supervisor works with the checker to establish the level of checking required. The checking procedure for assuring the quality of the design will vary from project to project. Following are some general checking guidelines:

a. Design Calculations

(1) For designs checked by an experienced checker, a review and initialing of the designer's calculations by the checker is acceptable. If it is more efficient, the checker may choose to perform his/her own calculations to check. All the designer and checker calculations shall be placed in one design calculation set.

(2) For designs checked by an inexperienced checker, a more thorough check should be performed by an inexperienced checker to enhance his/her understanding of structural design. In this case, the Unit Supervisor should provide the checker with a design example to be followed.

(3) Revision of design calculations, if required, is the responsibility of the designer.

b. Structural Plans

(1) The checker's plan review comments are recorded on the structural plans, including details and bar lists, and returned to the designer for consideration. If the checker's comments are not incorporated, the designer should provide justification for not doing so. If there is a difference of opinion that cannot be resolved between the designer and checker, the Unit Supervisor shall resolve any issues.

(2) If assigned by the Unit Supervisor, the checker shall perform a complete check of the geometry using CADD, hand calculations, or a geometry program.

(3) Revision of plans, if required, is the responsibility of the designer.

c. Quantities and Barlist

(1) The checker shall provide an independent set of quantity calculations. These together with the designer's quantity calculations shall be placed in the job file.

(2) Resolution of differences between the designer and checker shall be completed before the 100 percent PS&E submittal. The checker shall also check the barlist.

4. Structural Detailer Responsibility

The structural detailer is responsible for the quality and consistency of the contract plan sheets. The structural detailer shall ensure that the Bridge Office drafting standards as explained in BDM Chapter 11 are upheld.

a. Refer to BDM, Chapter 11, for detailing practices.

b. Provide necessary and adequate information to ensure the contract plans are accurate, complete, and readable.

c. Detail plan sheets in a consistent manner and follow accepted detailing practices.

d. Check plans for geometry, reinforcing steel congestion, consistency, and verify control dimensions.

e. Check for proper grammar and spelling.

f. On multiple bridge contracts, the structural detailing of all bridges within the contract shall be coordinated to maximize consistency of detailing from bridge to bridge. Extra effort will be required to ensure uniformity of details, particularly if multiple design units and/or consultants are involved in preparing bridge plans.

g. Maintain an ongoing program of related professional education including an understanding of bridge construction.

5. Specialist Responsibility

   There are currently three specialist positions in the Bridge and Structures Office. The three specialty areas in the Design Section are bearings and expansion joints, concrete (including prestressed concrete), and structural steel.

   The primary responsibility of the specialist is to act as a knowledge resource for the Bridge and Structures Office. The Specialists maintain an active knowledge of their specialty area along with a current file of products and design procedures. The Specialists maintain industry contacts. Specialists also provide training in their area of specialty.

   Specialists are expected to review and initial plans in their specialty area for contract plans prepared by other designers.

   Specialists also assist the Bridge and Structures Engineer in reviewing and voting on amendments to AASHTO specifications. They also are responsible for keeping their respective chapters of the Bridge Design Manual up to date.

   A secondary responsibility of the Specialist is to serve as Unit Supervisor when the supervisor is absent.

6. Design Unit Technical Responsibilities

   In addition to the specialty areas described above, each unit maintains a resource of technical knowledge in several technical areas. The following list describes additional specialty areas:

   - U.S. Coast Guard Permits
   - Cost Estimates
   - Bridge Special Provisions
   - Sign Supports, Light Standards, Traffic Signal Supports
   - Repairs to Damaged Prestressed and Steel Girders
   - Expansion Joint Modifications and Repairs
   - Retaining Walls (Including Structural Earth, Soldier Pile and Tie-Back, and Soil Nail Walls)
   - Seismic Retrofit
   - Noise Walls
   - Traffic Barrier Retrofits/Standards
   - Bridge Standard Plans and BDM
   - Software Development

   The resource/leadership responsibility for these technical areas does not necessarily include responsibility for performing all of the work relating to the technical area. For many of the technical areas, the design unit acts as a resource for the technical area and as a contact for industry and others.

7. Specification and Estimating Engineer Responsibilities

   The S&E Engineer is responsible for compiling the PS&E package for bridge and/or related highway structural components. This PS&E package includes Special Provisions (Bridge Special Provisions or BSPs and General Special Provisions or GSPs as appropriate), construction cost estimate, construction working day schedule, test hole boring logs and other appendices as appropriate, and the design plan package.

For a detailed description of the S&E Engineer's responsibilities, see Section 12.4.

8. Design Unit Supervisor Responsibility

   a. The Unit Supervisor is responsible to the Bridge Design Engineer for the timely completion and quality of the bridge plans.

   b. The Unit Supervisor works closely with the design team (designer, checker, and structural detailer) during the design and plan preparation phases to help avoid major changes late in the design process. Activities during the course of design include:

      (1) Evaluate the complexity of the project and the designer's skill and classification level to deliver the project in a timely manner. Determine both the degree of supervision necessary for the designer and the amount of checking required by the checker.

      (2) Assist the design team in defining the scope of work, identifying the tasks to be accomplished, developing a project work plan and schedule, and assigning resources to achieve delivery of the project on schedule and within budget.

      (3) Review and approve design criteria before start of design.

      (4) Help lead designer conduct face-to-face project meetings, such as: project "kick-off" and "wrap-up" meetings with Region, geotechnical staff, bridge construction, and consultants to resolve outstanding issues.

      (5) Assist the design team with planning, anticipating possible problems, collectively identifying solutions, and facilitating timely delivery of needed information, such as geometrics, hydraulics, foundation information, etc.

      (6) Interact with design team regularly to discuss progress, problems, schedule and budget, analysis techniques, constructibility and design issues. Always encourage forward thinking, innovative ideas and suggestions for quality improvement.

      (7) Arrange for and provide the necessary resources and tools for the design team to do the job right the first time. Offer assistance to help resolve questions or problems.

      (8) Help document and disseminate information on special features and lessons learned for the benefit of others and future projects.

      (9) Mentor and train designers and detailers on state-of-the-art practices and through the assignment of a variety of structure types.

   c. The Unit Supervisor works closely with the design team during the plan review phase. Review efforts should concentrate on reviewing the completed plan details and design calculations for completeness and for agreement with office criteria and office practices. Review the following periodically and at the end of the project:

      (1) Design Criteria

         - Seismic Acceleration Coefficient or "a" value
         - Foundation report recommendations, selection of alternates
         - Deviations from AASHTO, BDM, Documentation

      (2) Design Time and Budget

d. Review designer's estimated time to complete the project. Plan resource allocation for completing the project to meet the scheduled Ad Date and budget. Monitor monthly time spent on the project.

   At the end of each month, estimate time remaining to complete project, percent completed, and whether project is on or behind schedule.

   Plan and assign workforce to ensure a timely delivery of the project within the estimated time and budget. At monthly supervisors' scheduling meetings, notify the Bridge Projects Engineer if a project is behind schedule.

e. Advise Region of any project scope creep and construction cost increases. As a minimum, use quarterly status reports to update Region on project progress.

f. Use appropriate computer scheduling software or other means to monitor time usage, to allocate resources, and to plan projects.

g. Review constructibility issues. Are there any problems unique to the project?

h. Check the final plans for the following:

   (1) Scan the job file for unusual items relating to geometrics, hydraulics, geotechnical, environmental, etc.

   (2) Overall check/review of sheet #1, the bridge layout for:

   - Consistency — especially for multiple bridge project
   - Missing information

   (3) Check footing layout for conformance to Bridge Plan and for adequacy of information given. Generally, the field personnel shall be given enough information to "layout" the footings in the field without referring to any other sheets. Plan details shall be clear, precise, and dimensions tied to base references, such as: a survey line or defined centerline of bridge.

   (4) Check the sequence of the plan sheets. The plan sheets should adhere to the following order: layout, footing layout, substructures, superstructures, miscellaneous details, barriers, and barlist. Also check for appropriateness of the titles.

   (5) Check overall dimensions and elevations, spot check for compatibility. For example, check compatibility between superstructures and substructure. Also spot check bar marks.

   (6) Use common sense and experience to check structural dimensions and reinforcement for structural adequacy. When in doubt, question the designer and checker.

i. Stamp and sign the plans in blue ink.

9. Bridge Design Engineer's Responsibilities

   The Bridge Design Engineer is the coach, mentor, and facilitator for the WSDOT QC/QA Bridge Design Procedure. The leadership and support provided by this position is a major influence in assuring bridge design quality for structural designs performed by both WSDOT and consultants. The following summarizes the key responsibilities of the Bridge Design Engineer related to QC/QA:

a. When the structural contract plans are sealed by the Bridge Design Engineer, a structural/constructibility review of the plans is performed. This is a quality assurance (QA) function as well as meeting the "responsible charge" requirements of state laws relating to Professional Engineers.

b. Review and approve the Preliminary Bridge Plans. The primary focus for this responsibility is to assure that the most cost-effective and appropriate structure type is selected for a particular bridge site.

c. Participate in coordinating, scheduling, and communicating with stakeholders, customers, and outside agencies relating to major structural design issues.

d. Facilitate resolution of major project design issues.

e. Review unique project special provisions and Standard Specification modifications relating to structures.

f. Facilitate partnerships between WSDOT, consultants, and the construction industry stakeholders to facilitate and improve design quality.

g. Encourage designer creativity and innovation through forward thinking.

h. Exercise leadership and direction for maintaining a progressive and up to date Bridge Design Manual.

i. Create an open and supportive office environment in which Design Section staff are empowered to do high quality structural design work.

j. Create professional growth opportunities through an office culture where learning is emphasized.

k. Encourage continuing professional development through training opportunities, attendance at seminars and conferences, formal education opportunities, and technical writing.

10. General Bridge Plan Stamping and Signature Policy

The stamping and signing of bridge plans is the final step in the Bridge QC/QA procedure. It signifies a review of the plans and details by those in responsible charge for the bridge plans. At least one Licensed Structural Engineer shall stamp and sign each contract plan sheet (except the bar list).

For major projects, the Unit Supervisor and the Bridge Design Engineer will review, stamp, and sign the bridge plans. For routine bridge designs and transportation structure designs, the Unit Supervisor with a SE License and the designer with a Civil Engineer License will typically review, stamp, and sign the contract plans except for the barlist, which does not have to be stamped and signed.

B. PS&E Prepared by Consultant — Projects on WSDOT Right of Way

PS&E prepared by consultants will follow a similar QC/QA procedure as that shown above for WSDOT prepared PS&E's and, as a minimum, shall include the following elements:

1. WSDOT Consultant Liaison Engineer's Responsibilities

a. Review scope of work and consultant's QC/QA procedures.

b. Negotiate contract and consultant's Task Assignments.

c. Coordinate/Negotiate Changes to Scope of Work and QC/QA Procedures.

2. WSDOT Design Reviewer's or Coordinator's Responsibilities

    a. Early in the project, review consultant's QC/QA procedures, design criteria, and standard details for consistency with WSDOT practices and other bridge designs in project.

    b. Identify resources needed to complete work.

    c. Agree early on the structural concepts and design methods to be used.

    d. Identify who is responsible for what and when 30 percent, 90 percent, and 100 percent PS&E submittals are to be made.

    e. Monitor progress.

    f. Facilitate communication, including face-to-face meetings.

    g. Review consultant's design.

    h. Resolve differences.

    i. Verify that consultant's QC/QA plan was followed during design.

3. WSDOT Design Unit Supervisor's Responsibilities

    a. Encourage and facilitate communication.

    b. Early involvement to assure that design concepts are appropriate.

    c. Empower Design Reviewer or Coordinator.

    d. Facilitate resolution of issues beyond authority of WSDOT Reviewer or Coordinator.

    e. Facilitate face-to-face meetings.

4. WSDOT S&E Engineer's Responsibilities

    See Section 12.4.8.

5. WSDOT Bridge Design Engineer's Responsibilities

    a. Cursory review of design plans.

    b. Signature approval of S&E bridge contract package.

C. Consultant PS&E — Projects On County and City Right of Way

Counties and cities frequently hire Consultants to design bridges. WSDOT Highways and Local Programs Office determines which projects are to be reviewed by the Bridge and Structures Office.

WSDOT Highways and Local Programs sends the PS&E to the Bridge Projects Engineer for assignment when a review is required. The Bridge and Structures Office's Consultant Liaison Engineer is not involved.

A WSDOT Design Reviewer or Coordinator will be assigned to the project and will review the project as outlined for Consultant PS&E — Projects on WSDOT Right of Way (see Section 1.3.1.B).

Two sets of plans with the reviewers' comments marked in red should be returned to the Bridge Projects Unit. One set of plans will be returned to Highways and Local Programs. The Bridge Scheduling Engineer will file the other set in the Bridge Projects Unit.

The first review should be made of the Preliminary Plan first followed later by review of the PS&E and design calculations. Comments are treated as advisory, although major structural issues must be addressed and corrected. An engineer from the county, city, or consultant may contact the reviewer to discuss the comments.

1.3.2 Design/Check Calculation File

A. File of Calculations

The Bridge and Structures Office maintains a file of all pertinent design/check calculations for documentation and future reference. (See Section 1.3.7 Archiving Design Calculations, Design Files, and S&E Files).

B. Procedures

After an assigned project is completed and the bridge is built, the designer should turn in to the Unit Supervisor a bound file containing the design/check calculations. The front cover should have a label (See Figure 1, Section 1.3.7).

C. File Inclusions

The following items should be included in the file:

1. Index Sheets

   Number all calculation sheets and prepare an index by subject with the corresponding sheet numbers.

   List the name of the project, SR Number, designer/checker initials, date (month, day, and year), and Unit Supervisor's initials.

2. Design Calculations

   The design calculations should include design criteria, design assumptions, loadings, structural analysis, one set of moment and shear diagrams and pertinent computer input and output data (reduced to 8½" by 11" sheet size).

   The design criteria, design assumptions, and special design features should follow in that order behind the index.

3. Special Design Features

   Brief narrative of major design decisions or revisions and the reasons for them.

4. Construction Problems or Revisions

   Not all construction problems can be anticipated during the design of the structure; therefore, construction problems arise during construction, which will require revisions. Calculations for revisions made during construction should be included in the design/check calculation file when construction is completed.

D. File Exclusions

The following items should not be included in the file:

1. Geometric calculations.
2. Irrelevant computer information.
3. Prints of Office Standard Sheets.
4. Irrelevant sketches.
5. Voided sheets.

6. Preliminary design calculations and drawings unless used in the final design.
7. Test hole logs.
8. Quantity calculations.

1.3.3 PS&E Review Period

See BDM Section 12.4.10 for PS&E Review Period activities.

1.3.4 Addenda

Plan or specification revisions during the advertising period require an addendum. The Specifications and Estimate Engineer will evaluate the need for the addendum after consultation with the HQ Construction — Bridge, Region, and the HQ or Region Plans Branch. The Bridge Design Engineer or the Unit Supervisor must initial all addenda.

For addenda to contract plans, obtain the original drawing from the Bridge Projects Unit. Use shading to mark all changes (except deletions) and place a revision note at the bottom of the sheet (Region and HQ Plans Branch jointly determine addendum date) and a description of the change. Return the 11" by 17" signed original and copy to the Specifications and Estimate Engineer who will submit the copy to the HQ Plans Branch for processing. See Chapter 12 for additional information.

For changes to specifications, submit a copy of the page with the change to the Specifications and Estimate Engineer for processing.

1.3.5 Shop Plans and Permanent Structure Construction Procedures

This section pertains to fabrication shop plans, weld procedures, electrical and mechanical items, geotechnical procedures, such as: drilled shafts and tieback walls, and other miscellaneous items related to permanent construction.

The following is a guide for checking shop plans and permanent structure construction procedures.

A. Bridge Shop Plans and Procedures

1. Mark one copy of each sheet with the following, near the title block, in red pen or with a rubber stamp:

   Office Copy

   Contract (number)

   (Checker's initials) (Date)

   Approval Status (A, AAN, RFC or Structurally Acceptable)

2. On the Bridge Office copy, mark with red pen any errors or corrections. Yellow shall be used for highlighting the checked items. The red pen marks will be copied onto the other copies and returned to the Region Project Engineer. Comments made with red pen, especially for 8½" by 11" or 11" by 17" size sheets, shall be clear, neat, and conducive to being reproduced by Xerox. These comments should be "bubbled" so they stand out on a black and white Xerox copy. Use of large sheets should be discouraged because these require extra staff assistance and time to make these copies by hand.
3. Items to be checked are typically as follows: Check against Contract Plans and Addenda, Special Provisions, Previously Approved Changes and Standard Specifications.

a. Material specifications (ASTM specifications, hardness, alloy and temper, etc.).

b. Size of member and fasteners.

c. Length dimensions, if shown on the Contract Plans.

d. Finish (surface finish, galvanizing, anodizing, painting, etc.).

e. Weld size and type and welding procedure if required.

f. Strand or rebar placement, jacking procedure, stress calculations, elongations, etc.

g. Fabrication — reaming, drilling, and assembly procedures.

h. Adequacy of details.

i. Erection procedures.

For prestressed girders and post-tensioning shop plan review see BDM 5.6.3A and 5.8.6C respectively.

4. Items Not Requiring Check:

   a. Quantities in bill of materials.

   b. Length dimensions not shown on Contract Plans except for spot checking and is emphasized by stamping the plans: *Geometry Not Reviewed by the Bridge and Structures Office*.

5. Project Engineer's Copy

   Do not use the Project Engineer's copy (comments or corrections are in green) as the office copy. Transfer the Project Engineer's corrections, if pertinent, to the office copy using red pen. The Project Engineer's comments may also be received by E-mail.

6. Marking Copies

   When finished, mark the office copy with one of five categories in red pen, lower right corner.

   a. "A"

      Approved, No Corrections required.

   b. "AAN"

      Approved As Noted — minor corrections only. Do not place written questions on an approved as noted sheet.

   c. "RFC"

      Returned for Correction — major corrections are required which requires a complete resubmittal.

   d. "Structurally Acceptable"

      This is appropriate for items that are not required to be "Approved" per the contract, such as: work platforms, submittals from various local agencies or developers, and other items that are reviewed as a courtesy.

   e. "Structurally Acceptable But Does Not Conform to the Contract Requirements"

      This is appropriate when a deviation from the contract is found but is determined to be structurally acceptable.

If in doubt between AAN and RFC, check with the Unit Supervisor or Construction Support Engineer. An acceptable detail may be shown in red. Mark the plans *Approved As Noted* provided that the detail is clearly noted *Suggested Correction — Otherwise Revise and Resubmit*.

Do not mark the other copies. The Construction Support Unit will do this.

Notify the Construction Support Engineer if there are any structurally acceptable deviations to the contract plans. The Construction Support Engineer will notify both the Region Project Engineer and HQ Construction-Bridge, who may have to approve a change order and provide justification for the change order.

Notify the Unit Supervisor and the Construction Support Engineer if problems are encountered which may cause a delay in the checking of the shop plans or completion of the contract. Typically, WSDOT administered contracts require reviews to be completed within 30 days. The review time starts when the Project Engineer first receives the submittal from the Contractor and ends when the Contractor has received the submittal back from the Project Engineer. The Bridge Office does not have the entire 30-day review period to complete the review. Therefore, designers should give construction reviews high priority and complete reviews in a timely manner so costly construction delays are avoided. Time is also required for marking, mailing and other processing. It is the goal of the Bridge and Structures Office to return reviewed submittals back to the Project Engineer within 7 to 14 days of their receipt by the Bridge Construction Support Unit.

Return all shop drawings and Contract Plans to the Construction Support Unit when checking is completed. Include a list of any deviations from the Contract Plans that are allowed and a list of any disagreements with the Project Engineer's comments (regardless of how minor they may be).

If deviations from the Contract Plans are to be allowed, a Change Order may be required. Alert the Construction Support Unit so that their transmittal letter may inform the Region and the HQ Construction - Bridge.

Under no circumstances should the reviewer mark on the shop plans that a change order is required or notify the Project Engineer that a change order is required. The authority for determining whether a change order is required rests with HQ Construction - Bridge.

B. Sign Structure, Signal, and Illumination Shop Plans

In addition to the instructions described under Section 1.3.5A Bridge Shop Plans, the following instructions apply:

1. Review the shop plans to ensure that the pole sizes conform to the Contract Plans. Determine if the fabricator has supplied plans for each pole or type of pole called for in the contract.
2. The Project Engineer's copy may show shaft lengths where not shown on Contract Plans or whether a change from Contract Plans is required. Manufacturer's details may vary slightly from contract plan requirements, but must be structurally adequate to be acceptable.

C. Geotechnical Submittals

The Bridge Office and the Geotechnical Services Branch concurrently review these submittals which may include special design proprietary retaining walls, drilled shafts, ground anchors, and soldier piles. HQ Construction Office - Bridge is included for the review of drill shaft installation plans. The Construction Support Unit combines these comments and prepares a unified reply that is returned to the Project Engineer

1.3.6 Contract Plan Changes (Change Orders and As-Builts)

A. Request for Changes

The following is intended as a guide for processing changes to the design plans after a project has been awarded.

For projects which have been assigned a Bridge Technical Advisor (BTA), structural design change orders can be approved at the Project Engineer's level provided the instructions outlined in the *Construction Manual* are followed.

For all other projects, all changes are to be forwarded through the Construction Support Unit, which will inform the HQ Construction Engineer - Bridge. Responses to inquiries should be handled as follows:

1. Request by Contractor or Supplier

   A designer, BTA, or Unit Supervisor contacted directly by a contractor/supplier may discuss a proposed change with the contractor/supplier, but shall clearly tell the contractor/supplier to formally submit the proposed change though the Project Engineer and that the discussion in no way implies approval of the proposed change. Designers are to inform their Unit Supervisor if they are contacted.

2. Request From the Region Project Engineer

   Requests for changes directly from the Project Engineer to designer or the Unit Supervisor should be discouraged. The Project Engineer should contact HQ Construction - Bridge, who in turn will contact the designer or Unit Supervisor if clarification is needed regarding changes. The Construction Support Unit should be informed of any changes.

3. Request From the Region Construction Engineer

   Requests from the Region Construction Engineer are to be handled like requests from the Region Project Engineer.

4. Request From the HQ Construction - Bridge

   Requests for changes from HQ Construction - Bridge are usually made through the Construction Support Unit and not directly to the Design Unit. However, sometimes, it is necessary to work directly with the Design Unit. The Construction Support Unit should be informed of any decisions made involving changes to the Contract Plans.

5. Request From the Design Unit

   Request for changes from the Design Unit due to plan errors or omissions shall be discussed with the Bridge Design Engineer prior to revising and issuing new plan sheets.

B. Processing Contract Revisions

Changes to the Contract Plans or Specifications subsequent to the award of the contract may require a contract plan revision. Revised or additional plan sheets, which clearly identify the change on the plans, may be needed. When a revision or an additional drawing is necessary, request the original plan sheets from the Construction Support Unit's Bridge Plans Engineer and prepare revised or new original plan sheets.

Sign, date, and send the new plan sheets to the Bridge Plans Engineer. Send two paper copies to HQ Construction-Bridge. The Construction Support Unit requires one paper copy. The Design Unit requires one or more paper copies. One paper print, stamped *"As Constructed Plans"*, shall be sent to the Project Engineer, who shall use it to mark construction changes and forward them as *"As-Built Plans"* to the Bridge Plans Engineer upon project completion. The Designer is responsible for making the prints and distributing them.

This process applies to all contracts including HQ Ad and Award, Region Ad and Award, or Local Agency Ad and Award.

Whenever new plan sheets are required as part of a contract revision, the information in the title blocks of these sheets must be identical to the title blocks of the contract they are for (e.g., Job Number, Contract No., Fed. Aid Proj. No., Approved by, and the Project Name). These title blocks shall also be initialed by the Bridge Design Engineer, Unit Supervisor, designer, and reviewer before they are distributed. If the changes are modifications made to an existing sheet, the sheet number will remain the same. A new sheet shall be assigned the same number as the one in the originals that it most closely resembles and shall be given a letter after the number (e.g., if the new sheet applies to the original sheet 25 of 53, then it will have number 25A of 53). The Bridge Plans Engineer in the Construction Support Unit shall store the 11" by 17" original revision sheets.

Every revision will be assigned a number, which shall be enclosed inside a triangle. The assigned number shall be located both at the location of the change on the sheet and in the revision block of the plan sheet along with an explanation of the change.

Any revised sheets shall be sent to HQ Construction-Bridge with a written explanation describing the changes to the contract, justification for the changes, and a list of material quantity additions or deletions.

C. As-Built Plan Process

For more information on the as-built plan process for bridges, see the *As-Built Plans Manual*, prepared by the Bridge and Structures Office, dated August 2003. Copies are available from the Bridge Plans Engineer.

1.3.7 Archiving Design Calculations, Design Files, and S&E Files

A. Upon Award

The Bridge Plans Engineer will collect the Design File (Job File), S&E File and Design Calculations. Files will be placed in a temporary storage space marked as "Design Unit Document Temporary Storage". These cabinets will be locked, and only the Bridge Plans Engineer, the Scheduling Engineer, and the Office Administrator will have keys to them. The Design Files, S&E Files, and Design Calculations are stored under the contract number.

A Bridge and Structures staff member may access the Design Files, S&E Files, or Design Calculations by requesting the files from the Bridge Plans Engineer or the Scheduling Engineer, who will check out the files and note the date and person's name. If a person other than a Bridge and Structures Office staff member requests these documents, the approval of the Bridge Design Engineer or Bridge Projects Engineer will be required for release of the documents.

B. Upon Contract Completion

The designer will place a job file cover label on the file folder (see Figure 1) and update the file with any contract plan changes that have occurred during construction.

Two years after physical completion of the contract, the Bridge Plans Engineer will box and send the documents to the Office of Secretary of State for archive storage, except as otherwise approved by the Bridge Design Engineer.

The Bridge Plans Engineer will maintain a record of the documents location and archive status.

SR # _____ County _____ CS # _____

Bridge Name _____

Bridge # _____ Contract # _____

Contents _____

Designed by _____ Checked by _____

Archive Box # _____ Vol. # _____

Cover Label
Figure 1-2

1.3.8 Public Disclosure Policy Regarding Bridge Plans

The Bridge Management Engineer is the Bridge and Structures Office's official Public Disclosure contact and shall be contacted for clarification and/or direction.

Executive Order, E1023.0 Public Disclosure, which replaced *Directive D 72-21 Release of Public Records*, provides a specific procedure to follow when there is a request for public records. (See http://wwwi.wsdot.wa.gov/docs).

The Bridge and Structures Office is the "owner" of only two types of "official" records:
(1) Design Calculations (until they are turned over to the State Archives Office) and
(2) Bridge Inspection Documents.

No records will be disclosed without a written request. This request is to be specific.

As-built plans available on the Bridge and Structures website are not "official" as-built plans. The Regions are the owners of the "official" as-built plans and the procedure for providing requested copies of these plans is similar to the procedure outlined above with the following modifications:

- If you receive a written or verbal request for a set of plans from a person indirectly working for WSDOT (i.e. contractor, consultant), advise them to contact and request the plans from the WSDOT Project Engineer.
- If the request comes from a person directly working on a Bridge Office project as an on-call consultant, have them contact and request the plans from the Bridge and Structures Office's Consultant Liaison Engineer.

- If the request comes from a person not working for WSDOT, they must submit their written request to the person and address noted below and it will be forwarded to the appropriate Region to provide the requested documents.

  Written requests must be sent to:

  Records and Information Service Office
  Washington State Department of Transportation
  310 Maple Park Avenue P. O. Box 47410
  Olympia, WA 98504-7410
  Attn: Ms. Cathy Downs

1.3.9 Use of Computer Software

A. Protection of Intellectual Property

Many of the software tools used by the Bridge and Structures Office are licensed from commercial software vendors. WSDOT is committed to using these tools only as allowed by law and as permitted by software license. WSDOT employees shall comply with the terms and conditions of all licensing agreements and provisions of the Copyright Act and other applicable laws.

Before using any software tools WSDOT employees shall read and understand Instructional Letter 4032.00, Titled "Computer Software Piracy Prevention, and the Protection of Intellectual Property"[1]

B. Policy on Open Source Software

It is the policy of the Bridge and Structures Office to license its own engineering software as open source, and to prefer and promote the use of open source software, within the bridge engineering community.

To support this policy on open source bridge engineering software, the Bridge and Structures Office is a founding and participating member of the Alternate Route Project. The purpose of the Alternate Route Project is to serve as a focal point for the collaborative and cooperative development of open source bridge engineering software tools.

C. Approved Software Tools

A list of approved software tools available for use by WSDOT bridge design engineers is available at http://wwwi.wsdot.wa.gov/eesc/bridge/software. Note that this list is only available on the WSDOT intranet. WSDOT does not require consulting engineers to use any specific software tools, so long as the use of the tools are in accordance with sound engineering practice, and does not violate software licensing agreements and Copyright law.

When using personal design tools created by others, such as a spreadsheet or MathCAD document, the designer is responsible for thoroughly checking the tool to ensure the integrity of the structural analysis and design.

1.4 Coordination With Other Divisions and Agencies

During the various phases of design, it is necessary to coordinate the elements of the bridge design function with the requirements of other divisions and agencies. E-mail messages, telephone calls, and other direct communication with other offices are necessary and appropriate. Adequate communications are essential but organizational format and lines of responsibility must be recognized. However, a written request sent through proper channels is required before work can be done or design changes made on projects.

1.4.1 Preliminary Planning Phase

See Chapter 2.1 of this manual for coordination required at the preliminary planning phase.

1.4.2 Final Design Phase

A. Coordination With Region

Final coordination of the bridge design with Region requirements must be accomplished during the final design phase. This is normally done with the Region Project Engineer, Region Design Engineer, or Region Plans Engineer. Details such as division of quantity items between the Region PS&E and bridge PS&E are very important to a final contract plan set. The Region PS&E and bridge PS&E are combined by the Region Plans Branch. However, coordination should be accomplished before this time.

During the design of a project for a Region level contract, the Region shall provide a copy of the proposed structural plans (such as retaining walls, barrier, large culverts, etc.) to the Bridge and Structures Office. The Bridge and Structures Office will review these plans and indicate any required changes and then send them back to the Region.

The Region shall incorporate the changes prior to contract advertisement.

After contract advertisement, the Region shall return the original plan sheets to Bridge and Structures Office. These sheets shall be held in temporary storage until the Region completes the "As Constructed Plans" for them.

The Region shall then transmit the "As Constructed Plans" to Bridge and Structures Office where they will be transferred to the original plans for permanent storage. Upon request, the Region will be provided copies of these plans by the Bridge and Structures Office.

B. Technical Design Matters

Technical coordination must be done with the HQ Materials Laboratory Foundation Engineer and with the HQ Hydraulic Engineer for matters pertaining to their responsibilities. A portion of the criteria for a project design may be derived from this coordination; otherwise it shall be developed by the designer and approved by the Bridge Design Engineer.

The designer should ensure uniformity of structural details, bid items, specifications, and other items when two or more structures are to be advertised under the same contract.

1.5 Bridge Design Scheduling

1.5.1 General

The Bridge Projects Engineer is responsible for workforce projections, scheduling, and monitoring progress of projects. The *Bridge Design Schedule (BDS)* is used to track the progress of a project and is updated monthly by the Bridge Scheduling Engineer. A typical project would involve the following steps:

A. Regions advise Bridge and Structures Office of an upcoming project.

B. The Bridge Projects Unit determines the scope of work, estimates design time and cost to prepare preliminary plans, design, and S&E (see Section 1.5.2). The Unit Supervisor may also do this and notify the Bridge Projects Engineer.

C. The project is entered into the BDS with start and due dates for site data preliminary plan, project design, PS&E, and the Ad Date.

D. Bridge site data received.

E. Preliminary design started.

F. Final Design Started — Designer estimates time required for final plans (see Section 1.5.3).

G. Monthly Schedule Update — Each Unit Supervisor is responsible for maintaining a workforce projection, monitoring monthly progress for assigned projects, and reporting progress or any changes to the scope of work or schedule to the Bridge Projects Engineer.

H. Project turned in to S&E unit.

1.5.2 Preliminary Design Schedule

The preliminary design estimate done by the Bridge Projects Unit is based on historical records from past projects taking into consideration the unique features of each project, the efficiencies of designing similar and multiple bridges on the same project, designer's experience, and other appropriate factors.

1.5.3 Final Design Schedule

A. Breakdown of Project Man-Hours Required

Using a spreadsheet, list each item of work required to complete the project and the man-hours required to accomplish them. Certain items of work may have been partially completed during the preliminary design, and this partial completion should be reflected in the columns "% Completed" and "Date Completed." See Figures 1-A-2 and 1-A-3.

The designer or design team leader should research several sources when making the final design time estimate. The following are possible sources that may be used:

The "Bridge Design Summary" contains records of design time and costs for past projects. This summary is kept in the Bridge Projects Unit. The times given include preliminary plan, design, check, drafting, and supervision.

The Bridge Projects Unit has "Bridge Construction Cost Summary" books. These are grouped according to bridge types and have records of design time, number of drawings, and bridge cost.

B. Estimate Design Time Required

The designer or design team leader shall determine an estimate of design time required to complete the project. The use of a spreadsheet, or other means is encouraged to ensure timely completion and adherence to the schedule. Use 150 hours for one man month.

The following percentages should be used for the following activities:

Activity No.	Percentage
1	40
2	20
3	20
4	5
5	5
6	5
7	5
Total	100%

The individual activities include the specific items as follows under each major activity.

Activity No. 1 Design — See Section 1.3.1A2 — Includes:

1. Project coordination and maintaining the Design File.
2. Geometric computations.
3. Design calculations.
4. Complete check of all plan sheets by the designer.
5. Compute quantities and prepare barlist.
6. Preparing special provisions checklist.
7. Assemble backup data covering any unusual feature in the Design File.

Activity No. 2 Design Check — See Section 1.3.1A3 — Includes:

1. Checking design at maximum stress locations.
2. Checking major items on the drawings, including geometrics.
3. Additional checking required.

Activity No. 3 Drawings — See Section 1.3.1A4 — Includes:

1. Preparation of all drawings.

Activity No. 4 Revisions — Includes:

1. Revisions resulting from the checker's check.
2. Revisions resulting from the Unit Supervisor's review.
3. Revisions from S&E Engineer's review.
4. Revisions from Region's review.

Activity No. 5 Quantities — Includes:

1. Compute quantities including barlist.
2. Check quantities and barlist.

Activity No. 6 S&E — See Section 12.4. — Includes:

1. Prepare S&E.
2. Prepare working day schedule.

Activity No. 7 Project Review — Includes:

1. Unit Supervisor and Specialist's review.

C. Monthly Project Progress Report

The designer or design team leader is responsible for determining monthly project progress and reporting the results to the Unit Supervisor. The Unit Supervisor is responsible for monthly progress reports using information from the designer or design team leader. Any discrepancies between actual progress and the project schedule must be addressed. Report any revisions to the workforce assigned to the project, hours assigned to activities, or project schedule revisions to the Bridge Projects Engineer and Region.

The designer may use a computer spreadsheet, to track the progress of the project and as an aid in evaluating the percent complete. Other tools include using an Excel spreadsheet listing bridge sheet plans by title, bridge sheet number, percent design complete, percent design check, percent plan details completed, and percent plan details checked. This data allows the designer or design team leader to rapidly determine percent of project completion and where resources need to be allocated to complete the project on schedule.

1.6 Guidelines for Bridge Site Visits

The following guidelines are established to help all staff in determining the need for visiting bridge sites prior to final design. These guidelines should apply to consultants as well as to our own staff. In all cases, the Region project engineer should be made aware of the site visit so they may have the opportunity to participate. Region participation is very useful prior to preparing the preliminary bridge plans.

1.6.1 Bridge Rehabilitation Projects

This section pertains to major bridge rehabilitation projects and excludes rail and minor expansion joint rehabilitation projects. It is critical that the design team know as much as possible about the bridge which is to be rehabilitated. Recent bridge inspection reports, prepared by inspectors from the Bridge Preservation Office (BPO), contain useful information on the condition of existing bridges. The bridge inspection reports, as well as as-built plans, are available on the Intranet through *Bridge Engineering Information System (BEIST)*. BPO maintains *BEIST*.

As-built drawings and contract documents are also helpful, but may not necessarily be accurate. At least one bridge site visit is necessary for this type of project. In some cases, an in-depth inspection with experienced BPO inspectors is appropriate. The decision to perform an in-depth inspection should include the Unit Supervisor, Region, the Bridge Design Engineer, and the Bridge Preservation Engineer.

It may be necessary to use BPO's Under Bridge Inspection Truck (UBIT) if there is a need to access details and obtain measurements during the field visit. Advance planning and coordination with BPO will be necessary if UBIT equipment is required because of BPO's heavy workload and the need to provide traffic control well in advance of the site visit.

1.6.2 Bridge Widening and Seismic Retrofits

For this type of bridge project, it is important that the design team is familiar with the features and condition of the existing bridge. There is good information regarding the condition of existing bridges on *BEIST* and at the Bridge Preservation Office. As-built drawings and contract documents are also helpful, but may not necessarily be accurate. A site visit is recommended for this type of project if the bridge to be widened has unique features or is other than a standard prestressed girder bridge with elastomeric bearings.

1.6.3 Rail and Minor Expansion Joint Retrofits

Generally, photographs and site information from the Region along with as-built plans and condition survey information are adequate for most of these types of projects. However, if there is any doubt about the adequacy of the available information or concern about accelerated deterioration of the structural elements to be retrofitted, a site visit is recommended.

1.6.4 New Bridges

Generally, photographs and site data from the Region are adequate for most new bridge designs. However, if the new bridge is a replacement for an existing bridge, a site visit is recommended, particularly if the project requires staged removal of the existing bridge and/or staged construction of the new bridge.

1.6.5 Bridge Demolition

If bridge demolition is required as part of a project, a site visit would help the design team determine if there are unique site restrictions that could affect the demolition. If unique site restrictions are observed, they should be documented, included in the job file, and noted on the special provisions checklist.

Before making a site visit, the Bridge Preservation Office and the Region should be contacted to determine if there are any unique site conditions or safety hazards. Proper safety equipment and procedures should always be followed during any site visit.

When making a site visit, it is important to obtain as much information as possible. Digital photographs, video records with spoken commentary, field measurements, and field notes are appropriate forms of field information. A written or pictorial record should be made of any observed problems with an existing bridge or obvious site problems. The site visit data would then be incorporated into the job file. This information will be a valuable asset in preparing constructible and cost-effective structural designs.

It is important to include site visits as part of the consultant's scope of work when negotiating for structural design work.

1.6.6 Proximity of Railroads Adjacent to the Bridge Site

During the site visit, it should be noted if there are railroad tracks or railroad structures adjacent to the proposed bridge site. If there are, this will require that a *Railroad Shoring Plan* be included in the bridge plans for any foundation excavation adjacent to the railroad. The reason for including the *Railroad Shoring Plan* is to obtain advance approval of the shoring plan from the railroad so that waiting for the railroad's approval will not cause a delay during construction. The contractor will have to resubmit a revised *Railroad Shoring Plan* to the railroad for approval if the contractor wishes to change any details of the approved *Railroad Shoring Plan* during construction.

At the PS&E submittal phase, the Specifications and Estimates Engineer will send copies of the *Railroad Shoring Plan* to the WSDOT Railroad Liaison Engineer so it can be sent to the railroad for approval.

1.99 Bibliography

1. *LRFD Bridge Design Specifications*, Latest Edition and Interims. American Association of State Highway and Transportation Officials (AASHTO), Washington, D.C.
2. *Design Manual*, WSDOT M22-01.
3. *Construction Manual*, WSDOT M41-01.
4. *As-Built Plans Manual*, WSDOT Bridge & Structures Office, August 2003.